SPACE SHUTTLE

Overview

Before the Space Shuttle, launching cargo into space was a one-way proposition. Satellites could be sent into orbit, but they could not return. The world's first reusable space vehicle changed that, and it revolutionized the way people worked in space.

The Space Shuttle was approved as a national program in 1972. Part spacecraft and part aircraft, it required several technological advances, including thousands of insulating tiles able to stand the heat of reentry over the course of many missions, as well as sophisticated engines that could be used again and again without being thrown away. The airplane-like orbiter has three of these Space Shuttle Main Engines, which burn liquid hydrogen and oxygen stored in the large External Tank, the single largest structure in the Shuttle "stack." Attached to the tank are two Solid Rocket Boosters, which provide most of the vehicle's thrust at liftoff. Two minutes into the flight, the spent solids drop into the ocean to be recovered, while the orbiter's own engines continue burning until approximately eight minutes into the flight.

The Space Shuttle was developed throughout the 1970s. ***Enterprise***, a test vehicle not suited for space flight, was used for approach and landing tests in 1977 that demonstrated the orbiter's aerodynamic qualities and ability to land (after separating from an airplane). The first spaceworthy Shuttle orbiter, ***Columbia***, made its orbital debut in April 1981.

The first four missions of the new Space Transportation System (STS) were test flights to evaluate the Shuttle's engineering design, thermal characteristics, and performance in space. Operational flights began with STS-5 in November 1982, with a four-person crew on board. Over time, the crews grew in size; five people flew on STS-7 in 1983, and six flew on STS-9 later that same year. The first seven-person crew flew on STS 41-C in 1984, and in 1985, eight people—a Shuttle record—flew on STS 61-A.

The Space Shuttle changed the sociology of space flight. With such large crews, Shuttle astronauts were divided into two categories: pilots responsible for flying and maintaining the orbiter and mission specialists responsible for experiments and payloads. A new class of space traveler, payload specialists (who are not even necessarily career astronauts) also was created to tend to specific on-board experiments.

The reusable Shuttles together make up a fleet, with each vehicle continually being processed on the ground in preparation for its next flight. The second orbiter, ***Challenger***, debuted in 1983, followed by ***Discovery*** in 1984 and ***Atlantis*** in 1985. A fifth orbiter, ***Endeavour***, joined the fleet in 1991, to make its first flight in 1992.

The STS introduced several new tools to the business of space flight. The Remote Manipulator System, a 15.24-meter crane built by the Canadian Space Agency and designed to mimic the human arm, is able to move large and heavy payloads in and out of the Shuttle's 18.29-meter-long cargo bay. The Spacelab module, built by the European Space Agency (ESA), provides a pressurized and fully equipped laboratory for scientists to conduct diverse experiments, ranging in subject matter from astronomy to materials science to biomedical investigations. The Manned Maneuvering Unit backpack allows spacewalking astronauts to "fly" up to several hundred meters from the orbiter with no connecting tether.

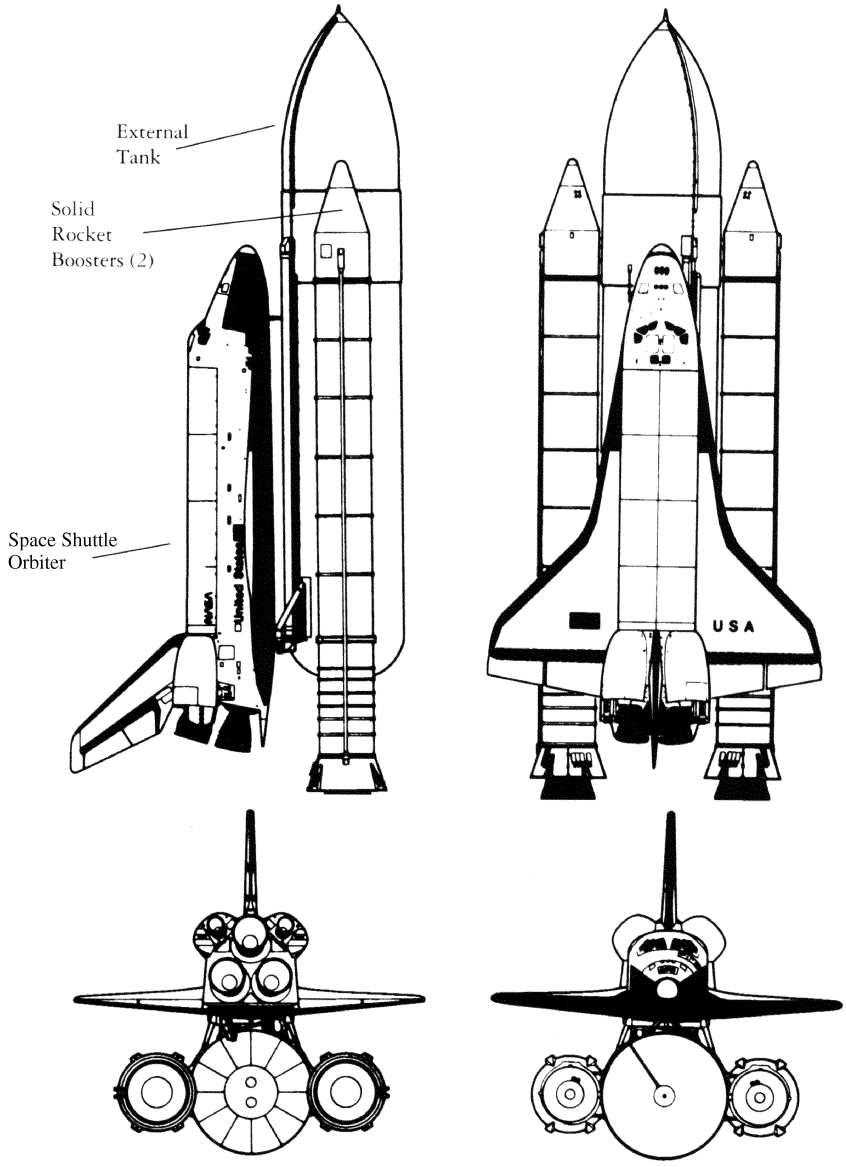
STS-35: Astro-1 looks out on the universe.

The Manned Maneuvering Unit has figured in several of the Space Shuttle program's most spectacular accomplishments. On STS 41-C in April 1984, the ailing Solar Max satellite was retrieved, repaired, and reorbited by the astronaut crew, all on the same flight. Later that same year, on STS 51-A, two malfunctioning commercial communications satellites were retrieved in orbit and brought back to Earth in the Shuttle cargo bay. Another malfunctioning satellite was fixed in orbit by the crew of STS 51-I in 1985.

Early in the Space Shuttle program, communications satellites were common payloads, with as many as three delivered into orbit on the same mission. The January 1986 ***Challenger*** accident, which resulted in the loss of the crew and vehicle because of a failed seal in one of the two

Solid Rocket Boosters, led to a change in that policy, however. Since returning to flight in September 1988, the Shuttle has carried only those payloads unique to the Shuttle or those that require a human presence. The majority of these have been scientific and defense missions. Among those payloads have been some of the decade's most important space science projects, including the Hubble Space Telescope, the Galileo Jupiter spacecraft, and the Gamma Ray Observatory.

In 1995, the Space Shuttle program added a new capability to its repertoire. In preparation for deployment of the International Space Station, the crew of the Space Shuttle began a series of eight dockings and five crew exchanges with the Russian space station *Mir*. U.S. astronauts spent time aboard *Mir*—sometimes several months at a time—acclimating themselves to living and working in space. They carried out many of the types of activities they would perform on the International Space Station and encountered conditions they would possibly encounter.



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